FIG. 9.—Cholesterine from the blood of the hepatic artery. ½ inch objective.

FIG. 10.—Cholesterine and stercorine from the blood of the hepatic artery. ½ inch objective.

FIG. 11.—Fatty substances from the blood of the hepatic vein. 1/12 inch objective.

FIG. 12.—Cholesterine and stercorine from the same specimen, examined the following day. ½ inch objective.

FIG. 13.—Cholesterine extracted from the bile. ⅙ inch objective.

FIG. 14.—Stercorine from the human feces. 4/10 inch objective.

FIG. 15.—Stercorine from the same specimen, after it had been melted, placed on a glass slide, covered with thin glass, and allowed to crystallize. The crystallization was very slow, occupying some weeks. This Fig. shows the splitting up of the borders and points of the crystals with the globules referred to on page 340. The globules were of variable size, and some of them were arranged in rows, which, with an inferior glass, might have been mistaken for varicosities on the needles. From their appearance in this specimen, after it had been so thoroughly purified, I am inclined to change the opinion expressed page 340, and regard them as composed of stercorine and not fatty impurities. ⅙ inch objective.

ART. II.—*Notes on Arrow Wounds.* By J. H. BILL, M. D., Assistant Surgeon U. S. A. (With three woodcuts.)

THE arrow is a weapon of the greatest antiquity. It is one with which, in this country, at least, we are all familiar; nevertheless, there is nowhere now extant an account of the wounds produced by it sufficiently accurate or definite to guide a surgeon in their treatment, or to give to the medical antiquary a record of their history and appearance. Before long these wounds will become of unfrequent occurrence, for our Indian tribes are fast being exterminated. We propose, in the first place, as a matter of historical interest, to state in this article what we know of arrow wounds. The subject still presents much of practical interest to the surgeon, and must continue so to do, in a greater or less degree, for the future. It will be some time before all our Indian tribes are "civilized off the face of all creation," and many a soldier and settler has yet to pay the death penalty for his courage or hardihood. Moreover, the bow and arrow is in use among the Tscherkesses of the Russian army, for the purpose of picking off sentinels without creating an alarm.[1] It is probable that a corps of carefully selected bowmen would be found of great use in our own army for like purposes. Franklin has suggested the employment of arrows in battles, to be shot from bows or fired from guns. Arrow wounds are, therefore, and for some time likely to be, of practical interest.

[1] Vide McClellan, Military Commission to Europe.

So much as an apology for the appearance of this article.

As is well known the arrow is the favourite weapon of all our Indian tribes, and it is such because in skilful and desperate hands the wound which it inflicts is attended with a fatality greater than that produced by any other weapon—particularly when surgical assistance cannot be obtained. The weapon is constructed not only to disable an antagonist, but also to kill sooner or later its victim.

In order fully to appreciate the subject of arrow wounds, it will be necessary to understand the mechanism and construction of the arrow itself. Let us briefly explain this.

The arrow is composed of two parts, a shaft and a head. The shaft varies in length from two to three feet. Usually it is made from a *limb* of the dogwood tree. A limb of a quarter-inch diameter is taken, soaked in water, the bark peeled off, and then cut into suitable lengths.

The straightening process is now commenced. The ends of the piece to be straightened are squared off, and two small and flat strips of wood placed transversely, as regards the long axis of the piece, and firmly lashed one to each end of the latter, in the manner of a cross. One of these sticks is held between the teeth, whilst the other is grasped by the hand. This end is now twisted to and fro by rotating the slip grasped by the hand, after the manner of a trephine. The fibres of the stick to be straightened after a while assume a spiral twist at the same time the stick itself is found to be straight. It often will require three days to straighten a single shaft. A notch is now filed at one end for the bowstring, and a slit made in the other to receive the straight quadrangular stem which comes off from the base of the head. The head is made of soft hoop iron, filed into the form of an isosceles triangle, and furnished with a stem to attach it to the shaft. This stem is an inch long by one-eighth of an inch broad, and is of one piece with the rest of the head. An arrow-head varies in length from half an inch to two inches, and half an inch to three-quarters of an inch in breadth at its base. No two arrows are alike. The stem at the base of the arrow-head is pushed into the slit made for it in the shaft, and held there by wrapping narrow ribbons of tendon spirally around the split sides of the latter, thus clamping these together, and the stem itself closely in their embrace. If it were not for these ribbons the head would be held loosely. It is then this ribbon of tendon that gives solidity to the arrow, and makes of a head and a shaft a perfect and a most dangerous weapon. The tendon removed and the weapon falls to pieces.

Such being the mechanism of the arrow, we can readily understand the danger peculiar to arrow wounds in general, a danger often seen in pistol-ball wounds of the chest. Let us suppose a case to illustrate and explain our meaning. An arrow is shot at a man at a distance of fifty yards. It penetrates his abdomen, and without wounding an intestine or a great vessel, lodges in the body of one of the vertebræ. The arrow is grasped by the shaft by some officious friend, and after a little tugging is pulled out. We said the arrow is pulled out. This was a mistake; it is the shaft only of the arrow that is pulled out. The angular and jagged head has been left buried in the bone to kill—for so it surely will—the victim. The explanation of such mishaps is this: the ribbon of tendon which compressed together the split sides of the end of the arrow, and so clamped the head and the shaft together, had become wetted with the fluids effused in the course of the wound. When wetted, it was, of course, lengthened, and, if lengthened, loosened. It ceased longer to bind together the split sides of the shaft; this and the head were, consequently, very feebly united and readily detached. Experience has abundantly shown, and none know the fact better than the Indians themselves, that any arrow wound of chest or abdomen, in which the arrow-head is detached from the shaft and lodged, is mortal. From this we conclude that the danger *peculiar* to all arrow wounds is, *that the shaft becoming detached from the head of an implanted arrow, leaves this so deeply imbedded in a bone that it cannot be withdrawn, and that, remaining, it kills.* It is not possible with forceps to extract an arrow-head so lodged (if lodged deeply), throwing aside the difficulty of discovering and the danger of searching for it. The blades of forceps long enough for this purpose (supposing the foreign body deeply lodged in the chest) would bend too readily with the force required for the removal of the missile. The greatest force is sometimes required for the extraction of an arrow-head so lodged. We have seen an arrow shot at a distance of one hundred yards, so deeply imbedded in an oak plank, that it required great force, applied by strong tooth-forceps, to remove it. In the case of a man shot in the shaft of the humerus by an arrow, it was only after using both knees, applied to the ends of the bone as a counter-extending force, and a stout pair of tooth-forceps, that we succeeded in removing the foreign body. Another similar case will be mentioned hereafter. Asst. Surgeon McKee had a case, also, in which considerable force was required to extract an arrow-head lodged in the trochanter, and other instances illustrating the difficulty sometimes encountered in the removal of arrow-heads lodged in bone could readily be adduced.

We have dwelt thus at length upon the mechanism of the arrow because we consider that upon a rightful understanding of the same must depend an intelligent and a skilful treatment of the wound which it occasions. The arrow-head removed by proper treatment, and we have an ordinary punctured wound, such as a poniard or stiletto would make. The wounds inflicted by these last named weapons are dangerous and troublesome for this reason. When such a weapon pierces any deep tissue, it must do so through some other tissue possessed of a contractile or muscular power. As soon as the weapon is withdrawn, this last named tissue contracts, and thus draws the wound in itself upwards or downwards, interrupting the continuity of the wound as a whole; whence it happens that all such wounds, the pus or effused liquids finding no outlet, are apt to be attended with burrowing of matter and deep-seated abscess. This remark applies to arrow wounds, although they partake of the nature of incised wounds, and, therefore, oftener heal by first intention than do the punctured wounds of the stiletto or bayonet, attended as these are with much bruising and tearing of tissues. Arrow wounds are often complicated by profuse hemorrhage, and for the same reason that in bayonet wounds abscesses form, through inability of matter, to find a ready outlet, in arrow wounds hæmatomata result. In fact, when arrow wounds suppurate, they generally do so through disorganization of these collections of blood.

It is occasionally the practice of some of our Indian tribes to poison their arrows. The plan pursued is this (on the testimony of a Moquis Indian.) The liver of some animal is exposed, and a rattlesnake compelled to insert his fang into it. The animal is at once killed, the liver removed, and wrapped up in the skin and buried. After seven or eight days the bundle is dug up, and the arrow-heads dipped in the pulpy and putrescent mass inclosed in the skin. After they are dry they are dipped in blood, again dried, and preserved for use.

We have never witnessed this process, but have seen arrows said to have been subjected to it. A horse, however, was shot on a late Nabajoe campaign in the flank with an arrow. He swelled up enormously, evidently suffered much pain, and died in the course of a night, certainly from the effects of a poison, as the wound inflicted by the arrow was not mortal, either from its seat or its severity. Strange to say such arrows are of infrequent use. Among some seventy-six cases of arrow wounds received from Nabajoe, Apache, and Utah Indians, we have seen no case of poisoned arrow wound in the human subject, nor have we heard of such a case, after careful inquiry. Of course a wound of this nature, if it involves parts beyond the reach of knife or cautery, is fatal.

What parts of the body are oftenest wounded by the arrow, and what is the relative fatality? The following table of cases, falling principally under our own observation, will show:—

	HEAD.		Spinal Marrow.	Neck.	CHEST.		Heart.	ABDOMEN.		Upper Extremity.	Lower Extremity.	Total.
	Brain wounded.	Brain not wounded.			Lung wounded.	Lung not wounded.		Intestine wounded.	Intestine not wounded.			
Number of cases saved	1	2		2	2	9			3	27	5	51
" " " died	2		1		4		2	15	3[1]	1	1	29
Total	5		1	2	15		2	21		28	6	80

---

[1] One of these perished from a gunshot wound.

The above table includes all the reliable cases of arrow wounds falling under our notice.

On referring to it, it will be seen that the upper extremity is oftenest wounded, next comes the abdomen, next the chest, next the lower extremity, next the head, and, lastly, the neck. The reason that the upper extremity is so often wounded, is that a person can see an arrow darting towards him, and very naturally putting out his arm to ward it off, receives a wound oftener in this member than in any other. Wounds of the abdomen are oftenest fatal (more than three-fifths of the total deaths occurred from wounds of abdomen), next come wounds of chest, wounds of head and heart next, and wounds of spinal marrow, and upper and lower extremity are last.

An expert bowman can easily discharge six arrows per minute, and a man wounded with one is almost sure to receive several arrows. In the above table, when a man was wounded in more places than one, the most serious wound, or that which immediately caused his death, is recorded. We have not seen more than one or two men wounded by a single arrow only. In three of our soldiers shot by Nabajoes, we counted forty-two arrow wounds; this is an extreme case, as the manufacture of the arrow costs the Indian too much labour and time to expend one unnecessarily. The cause of death in the twenty-nine fatal cases may be thus summed up :—

CAUSE OF DEATH.	Immediate Hemorrhage.	Peritonitis.	Compression of brain.	Wound of Heart.	Empyema.	Tetanus.	Pneumonia.	Wound of Sp. Cord.	Other Injuries.	Total.
Number of cases	7	13	2	2	1	1	1	1	1	29

Keeping in view the real cause of dread in arrow wounds—to wit, the lodging and fixation of the iron head in a bone—let us now proceed to consider the subject from a more limited view, and investigate the arrow wounds of each separate part of the body.

First, then, for the simplest case; an arrow wound involving no parts essential to life. Let us suppose a case.

A man is shot by an arrow which passes through integuments and muscles, and grazing the bone, makes its exit on the other side of a limb. What appearance is presented after the accident? We will find at the spot where the arrow entered, a very small and narrow slit, surrounded by a circular patch of bruised integument of a dusky-red colour. It is almost impossible to say whether the slit was made by a pistol-ball or an arrow, so closely does the entrance wound made by an arrow resemble that made by a small ball. On the other side of the limb another slit, somewhat larger than that above described, is seen, but not surrounded by the red areola. This is the exit wound. What is the treatment? Apply cold or evaporating lotions, place the limb at perfect rest, let the patient diet himself, and the chances are favourable of such a wound healing by first intention. At all events this is the indication. Ordinarily, such a wound will be quite well in a week. If we fail in our efforts at healing by first intention, and matter forms, bandages, compresses, and an early evacuation of the collection is the treatment; generally, the pus will find its way to the surface by the wound. It is not considered necessary to illustrate further, although numerous cases might be cited in support of what we say. In such cases the rule for any other punctured and incised wound obtains. If any artery is divided, follow Guthrie's rule, and tie the divided vessel in the wound itself, securing both the cardiac and distal ends of the artery. We have seen but one case of a large artery of a limb divided by an arrow, and that case terminated fatally before we saw the man. He was a Mexican, and was shot in the groin while on horseback. The arrow pierced the femoral artery just below Poupart's ligament. The man lived twelve hours, but was brought into the post dead. The possibility of the deep vessels of a limb being pierced by an arrow, must be apparent to any one, and it is as well to keep it always in mind, and be prepared to tie the vessel before a diffused traumatic aneurism is formed, which would greatly increase both the danger and difficulty of the operation. Suppose a nerve-trunk has been partially divided, and all the unpleasant symptoms consequent on such an accident ensue, what is to be done?

In such a case we think a surgeon justifiable in enlarging the wound, and completing the division of the nerve.

Private Martin, of the 3d Infantry, was shot in his right leg by an arrow —the arrow passing out. I saw him shortly after the receipt of the injury. The only thing remarkable was the agonizing pain, referable to the small toes and outside of foot. I suspected a wound of the musculo-cutaneous nerve, and decided to cut down upon it, and, if necessary, to divide it. This I did, and found the nerve as I had diagnosed, wounded. I divided it, and the pain ceased, numbness taking its place. The man did well, the *wound healed* by granulation, and ultimately sensation was regained in the outside of the foot. The man was sent to duty on the twenty-eighth day. Of course, such a procedure will not be rashly undertaken on a large nerve-trunk, nor in any case in which pain is absent.

If an arrow, instead of passing through a limb, strikes a bone, it will lodge, and that, too, so deeply, that nothing but forcible traction and judicious movement will extract it. The wound should be enlarged with a bistoury, as the shaft of an arrow is always so tightly grasped by the tissues through which it passes, that a forceps cannot be introduced for its extraction. An incision an inch to two inches in length will suffice, but it must divide to this extent all the tissues, through which the arrow has passed. After this has been made, pass down a finger, and explore the parts; ascertain the position, seat, and depth of the arrow-head in the bone. Then guide down upon the finger a pair of straight tooth forceps, and make these embrace the arrow-head; remove the finger gently, till the arrow shifts from side to side, so as to loosen its seat in the bone. Firm traction being now made on the head by the forceps, the extraction will be sufficiently easy. Treat the wound as a simple arrow wound. Supposing that the shaft has become detached from the head of the arrow before the patient is seen. This is an unfortunate occurrence. Frequently we will fail in detecting the arrow-head, and even if found, its extraction must be a matter of difficulty. The wound should be enlarged, and the finger used for exploring, as in the previous case. If the head is found, the forceps must be applied, the finger disengaged from the wound, and the forceps firmly grasped. A gentle rocking motion of the handles of the latter, such as a dentist uses to extract a tooth, will, if enough of the arrow-head projects out of the bone, suffice to disengage it. If it is deeply buried, nothing but sheer brute force will accomplish its extraction. The following is a case in point.

Private Bishop was shot in the head of the humerus with an arrow, and the shaft having been plucked out, the iron head was left deeply imbedded in the bone. The man was in great pain, synovia was flowing out of the wound, and all motion was lost. I enlarged the wound, introduced my finger, and so ascertained the position and depth of the arrow-head. It was very deeply implanted. I introduced forceps, seized it by its base, but could obtain scarcely any "purchase." I at last succeeded in grasping it tightly, and bracing my knees against the patient's thorax, I applied all the traction I could muster. Suddenly the arrow-head flew out of its seat, and I would have fallen on the floor, had not the steward caught me. The wound healed well. It was treated by evaporating lotions, and a rigorously antiphlogistic diet for the patient. Motion in the joint was not lost, though somewhat impaired.

I have already alluded to another case, in which I removed an arrow from the shaft of the humerus by bracing the end of the humerus against my knees, and then applying all my strength to the foreign body by means of forceps.

There is yet one case of arrow wound of limb of which we must speak, in which the head lodges in a bone, but with a curious modification. It is this. The point of the arrow-head scrapes the bone near the edge of this latter, and just as it does so, the muscles of the limb contract violently, and bend the point of the weapon. The arrow passes on, and again the muscles contract, and again the point is bent, and so on; so that by the time the progress of the arrow is arrested, its head is bent to resemble a fish-hook, the point, however, being firmly implanted, and immovably bound down to the bone by the periosteum and cartilaginous structures, which it has stripped off from their attachments. Of course, the greater the traction applied to an arrow-head so lodged, the more firmly will it be imbedded. In such a case, the finger carried down to the foreign body, gives us all the information that is needed, and it is just because such cases as these are of rather frequent occurrence, that the digital examination of arrow wounds should always be practised, when possible. In such a case, the head of the arrow having been seized by forceps, as usual we vibrate these from side to side, but instead of pulling, we gently push, so as to disengage the point of the head from any lodgment it may have made in the bone, and then by gentle movements of a rotatory character, aided by the finger, the final removal of the foreign body will not be difficult. The finger should be kept on the point of the bent arrow-head, in order to prevent entangling this in such tissues as may be in the way.

We have seen two cases such as that above described, and have heard of two others.

The first case was that of a Mexican shot by an Apaché, the arrow-head striking the ulna in its upper third. The man withdrew the shaft immediately, and then came to me. I enlarged the wound, and prudently made an examination with my finger. The entrance wound of the arrow was on the flexor side of the forearm, about an inch below and to the inside (ulnar side) of the coronoid process of the ulna. The ulnar artery was on the radial side of the wound. On passing my finger down, I readily found the arrow-head, but it had wrapped itself around the bone, its point being imbedded in the periosteal tissues of the outer (radial) side of the ridge on the posterior surface of the ulna. With a little care, I readily extracted the missile. Like all such wounds, this one healed readily.

The second case was that of Corporal Scott, shot at Fort Defiance, by a Nabajoe. I enlarged the wound, and followed the arrow shaft with my finger until I reached the iron head. The arrow had entered on the posterior and outer aspect of the leg, penetrated the muscles of the calf, scraped the fibula about two inches from its head, and then wrapped itself firmly around this bone. The hemorrhage being very profuse and arterial, I extracted the foreign body as soon as possible. I then searched for the bleeding vessel (muscular branch of the peroneal), and tied it at one end. The other I could not find. The wound did well until the second day, when hemorrhage returned. I failed to find any bleeding vessel, so I used the anhydrous chloride of iron, made by the sublimation process, and dissolved in very strong syrup.[1] The wound was sponged out, and the solution containing twenty grains of anhydrous chloride, finely powdered, dissolved, and suspended in strong syrup, injected into the wound by means of a syringe. This treatment succeeded, and the hemorrhage did not recur. The man made a tedious recovery.

Dr. Kennon informs us that he had a case of this kind, in which he removed from the thigh of a Mexican an arrow-head which had been lodged six months previously in the femur. The surgeon attending the man at the time of the accident, had failed to remove the foreign body, contenting himself merely with a withdrawal of the arrow shaft. The head had there produced abscesses, caries, and infiltration of tissues with pus, and the most serious constitutional symptoms, the patient being brought to the verge of the grave with hectic. Dr. K. instituted a search for the cause of the mischief, and after a prolonged and bloody dissection, came upon it. He found that the soft iron of which the head was made, had bent into a semicircle, and that the femur was half surrounded by this. The doctor extracted the missile, supported the limb on a splint, applied compresses and bandages, and administered the proper constitutional treatment. The man recovered a good use of his limb.

---

[1] The object in using strong syrup for the solution and suspension of this substance, is to preserve it anhydrous. *Vide* an article by author in *Am. Journ. of Pharmacy*, for July, 1858. As prepared in a strong syrup, we regard this as the best of the hæmostatics.

A fourth case, illustrating this peculiar accident, occurred in the practice of Asst. Surgeon Clements, U. S. A., during the last campaign against the Nabajoes. A surgeon was shot through the upper part of the posterior fold of the axilla with an arrow, which penetrated deeply. The shaft was pulled out, leaving the head imbedded. The man then went to the doctor. The case was treated by Dr. Clements for six weeks or two months, but without benefit, and finally it was decided that the arrow-head must be removed. The doctor accordingly made a T-shaped incision over the scapula, cutting through integument and muscle, and exposing the bone. The foreign body was, after some search, found, but so twisted and bent, that notwithstanding the large incisions made, it was only after the application of some force by strong tooth-forceps, that the head was removed. Secondary hemorrhage took place twelve hours after, but was checked by (we believe) the actual cautery. The man slowly recovered.

We should gladly have given this case in full, had we been acquainted with all the particulars. It illustrates, in addition to the peculiarity in the nature of the wound, the proper treatment in all such cases.

If a surgeon is called to a case in which an arrow-head is left lodged in a bone, and in which, from any cause, immediate extraction is impossible, what should be the treatment? Shall cold applications and rest, and all the usual means for subduing inflammation be enjoined! We answer, no. In the first place, such means will be perfectly futile. An arrow-head cannot become encysted like a ball; it presents too many sharp angles and edges, and is too generally irritating for any such event to be expected. Nor will it become encased in bone. The inflammation which it will always produce, is the effort of nature to throw off the foreign body, and it cannot be checked. It will go on to suppuration, abscesses will form, and pus will burrow, until at length, if some active interference is not interposed, the member is rendered worthless. In such a case, the treatment must be expectant. Place the limb on a splint, make the orifice of the wound the most depending portion thereof, and finally introduce a sponge-tent, or, what is better, perhaps, a drainage-tube of Chassaignac. From a fair trial of this instrument in several cases of gunshot wound, we can cordially recommend it both in gunshot wounds, and in all wounds where deep suppuration is expected. In addition to a tent or drainage-tube, bandages and compresses will be found necessary, particularly towards the conclusion of the case. They should never be applied so tightly as to produce uneasiness, but should always keep up just that amount of pressure which will serve to prevent the burrowing of matter, and check motion of the muscles. Perhaps, after pursuing this course for a while, the arrow-head may be detected, and if detected, extracted with facility. In any event, frequent search should be made for it. Generally, we will at length succeed in removing the foreign body; but all things else failing, as time, strength, and patience may, we must operate.

It is not possible to lay down any fixed rules for such an operation. The incisions should be large and free—boldness rather than prudence governing our actions. We might as well cut the patient's limb up until we do find the arrow-head, for if it is left, amputation will be necessary, and worse than this can hardly ensue from the "cutting up" we have advised. We would, if we undertook such an operation, make up our mind to find the arrow-head, even if it were necessary to tear up every fasciculus of every muscle of the injured member. It is just in such cases as this that the motto, "Operative surgery is the art of cutting and tying what you cut," finds its best exemplification. As such a wound will be attended with hemorrhage, rendering all its steps more difficult, it will be proper to compress the main artery of the limb by the hand of an assistant. Having thus briefly considered the subject of arrow wounds of parts not essential to life, let us recapitulate.

1st. An arrow passing through a limb makes a clean half punctured, half incised wound, which will generally heal by first intention, if proper treatment be instituted.

2d. An arrow lodging in bone requires some force, much tact, strong forceps, and an ample incision for its removal.

3d. This removal should always be effected as soon as possible after the receipt of the injury, *and the greatest care taken in doing so not to detach the shaft from the head of the arrow.*

4th. Always use the finger to explore the lodgment of an arrow-head, and to determine whether it is bent or straight.

5th. If we fail to detect or to extract an arrow-head lodged in bone, we wait a few days, trusting to suppuration, tents, position, etc., and then search again and again for it.

6th. If we fail in removing the foreign body by these means, we operate, making large incisions and compressing the artery of the limb.

Let us now proceed to consider arrow wounds of the head. An arrow, unless it strikes at a short range, or perpendicularly to the skull, will usually glance off, making a scalp wound—a wound here requiring no particular notice, as it presents nothing peculiar.

An arrow wound of the orbit will usually be mortal, the missile easily penetrating the bones of the skull in this situation and then wounding the brain. We have not seen such an injury, but have been informed by Nabajoe Indians that when the Delawares, in 1845, made an invasion of their country, one of the band was wounded in this manner and died immediately. History assigns King Harold's death to an arrow wound of the orbit.

If an arrow should strike the skull at a short range and perpendicularly to its surface, it will probably penetrate. In doing this the arrow-head makes in the outer table by compressing the particles of bone surrounding it, a narrow puncture of the width of the thickness of the arrow-head, and of the length of the breadth of the same; a puncture such as it would make if pushed into a bit of wax. But in addition to this a crack usually commences from both ends of this puncture, and extends itself in an opposite direction from its fellow, over a distance proportional to the momentum which the arrow possessed. In its passage through the outer table, the arrow-head loses its momentum, and strikes the inner table with a greatly reduced velocity, a velocity not sufficient to allow the arrow-head to penetrate it and pass into the substance of the brain; but enough to cause a scale of the inner table to be fractured off; and whilst still sticking to the point of the arrow-head, to be slightly driven upon (seldom into) the brain itself. Under these circumstances, the usual symptoms of compression will arise, as in any other case. The man falls insensible to the ground. Hence it happens that the surgeon is seldom called to treat such cases. The man being so wounded and insensible falls an easy prey to the vindictive savage who shot him, and such a chance is never neglected. If, however, we do have such a case to treat, we remove the arrow-head and elevate the depressed bone. Both of these indications will usually be filled by making gentle traction on the arrow-head; for as the arrow-head is withdrawn, it draws with it the scale of depressed bone, which is sticking to its point, until this last is elevated into its proper place. If, on removing the foreign body in the manner indicated, we find the symptoms of compression still present, we infer that we have failed to elevate the depressed bone. But in any such event we must trephine. We trephine not so much with the purpose of elevating the depressed bone as with the object of removing the cause of the compression, whatever this may be. The after treatment of such a case must be most strictly anti-inflammatory, the first signs of cerebral disturbance being met with bleeding and one smart purge. Croton oil has answered best in our hands. After the elevation of the fragment, close the wound with collodion, shave the head, apply cold unremittingly, and if inflammation does ensue, as indicated by cerebral derangements, treat it as above indicated. The bleeding, however, must be *ad deliquium*. If in any case suppuration should commence, and abscess form, then also we must resort to the trephine. Such a case will almost surely end fatally.

Miguel "Nigro," the post-guide at Fort Union, was shot with an arrow by a Utah Indian. I found the arrow-head sticking in the left parietal bone, the shaft having been detached. I made traction on it, and drew it out of the wound. The symptoms of compression present at once vanished, the man turned over and sneezed, and rose up on his feet. I had made arrangements to trephine the skull if necessary, but I had probably restored to its proper level that portion of the inner table which was depressed, so that measure was unnecessary. The cause of the compression was gone, and I had nothing to trephine for. The next day the man complained of headache. His face was flushed, eyes suffused, pulse hard, and irregular. I ordered croton oil, shaved his head, and applied cold. Presently, when delirium came on, I bled him until he fainted. This bleeding was repeated the night of the same day. The next day he was greatly better; the croton oil had operated well. The man was left to recover, which he did in three weeks.

We have examined two other cases of arrow wound of skull. In both, the subjects were dead. In both there was a depression of the inner, with a fissure of the outer table. In one of the cases the wound was over the right frontal bone, and this was fissured into the coronal suture. The depressed portion of the inner table measured a half inch in diameter, and was firmly attached to the point of the arrow-head, so that on withdrawing this latter, I could readily elevate the depressed scale. The second case was that of an Indian, shot with an arrow, in one of the Wormian bones. The inner table was just barely pierced by the arrow-point. The fragment of bone depressed was driven upon the membranes over the left posterior cerebral lobe, without, however, tearing these. In neither case was hemorrhage observed; neither died immediately.

Lieutenant Maxwell was shot in the head by an arrow which penetrated his skull, wounding the brain, and killed him almost immediately. We did not see the case, and, therefore, we refrain from noticing it farther.

Arrow wounds of the trunk, from their greater importance and more frequent occurrence, comprise the greater part of our subject. The Indians know well the fatality of such wounds, and aim always at the umbilicus; hence one cause of the frequency of these wounds.

An arrow sometimes goes through the chest and passes out. It would always do so if it were not that it can scarcely miss hitting a bone. Hence it happens that a lung is not nearly so often wounded by an arrow as an intestine. Of fifteen cases of arrow wound of chest falling under our notice, in New Mexico, in seven cases only was the lung wounded, and in one of these, the heart was wounded also; and in four of these (rejecting the case complicated with heart wound) the patients died. In two, the death was by hemorrhage; in one, by empyema; in one by pneumonia, complicated with peritonitis.

An arrow wound of lung is from first to last more dangerous than a gunshot wound of the same parts. There are three reasons for this. First, the hemorrhage occurring at the time of the injury, or a few hours after, is much more profuse than in an ordinary gunshot wound. A ball going through the chest does not often give trouble from hemorrhage, unless it should wound a large vessel. The reason is, that a ball tears and bruises, while an arrow makes clean slits and punctures. Secondly, an arrow wounding the lung, is almost sure to lodge, whilst a ball generally passes. Now, hear what Guthrie says about balls that lodge in the chest.[1]

"General McDonald, of the Royal Artillery, was present at Buenos Ayres when a bombardier of that corps received a wound from a two pound shot, which went completely through the right side, so that when led up to the general, who was lying on the ground, he saw the light quite through him, and supposed, of course, that he was lost. This, however, did not follow, and some months afterwards the man walked into General (then Captain) McDonald's quarters so far recovered from the injury as to be able to undertake several parts of his duty before he was invalided, *thus, proving the advantage of a shot, however large, going through rather than remaining in the chest.*"

Why is this? Is it feared that a ball lodging will be more apt to induce pneumonia than one passing completely through the chest? Is it hemorrhage from wounded lung that is so much feared? No! It is the danger of exciting and keeping up a low form of inflammation of the pleural sac, such as is sure to lead to effusion of serum, and then to collections of pus in its cavity. In a word, it is the danger of empyema. Guthrie says of this[2]: "It is the great fact to be attended to in the treatment of pistol wounds of chest, or those made by small balls which do not pass through." Now if this applies to balls, it applies to arrows in a higher degree. If an arrow-head becoming detached from its shaft is *permanently* lodged in a vertebra, or a rib, empyema will result. The third danger peculiar to arrow wounds of lung is the supervention of emphysema twelve or fifteen hours after the receipt of the injury. It is rather an inconvenience than a danger.

In an attack made by a company of Mexicans on the Nabajoe Indians, thirty men were wounded, and twenty-two killed, or died of their wounds. Many of these cases were wounded by arrows. They all came under the writer's care. Of arrow wound of lung there were in all five cases; three of these died, two recovered.

Case I. Name unknown. Man found dead among many others; skull uninjured. Three arrow wounds, of which two wounded the lungs. Ground covered with pools of this subject's blood. Chest, on being opened, was found as follows: About two pounds of semifluid blood were found in left pleural sac, and a somewhat smaller quantity in the right. Bronchi, in places, engorged with blood. No large vessels injured. One arrow had lodged in the body of a vertebra. It had entered below the right nipple. The other arrow went through the chest from right to left and passed out. Subject was probably asphyxiated with blood.

Case II. Salvador Martinez, shot through chest with an arrow which entered between the fifth and sixth ribs on the right side, and passed out between the seventh and eighth on the left. The man vomited blood.

---

[1] Guthrie's Commentaries, p. 480.

[2] Commentaries, p. 473.

Arrow had been extracted when I saw him. I had him taken to Fort Defiance, where he arrived very much exhausted. He rallied, however, and took a half a grain of sulphate of morphia at bedtime. The next morning an ordinary domestic enema was used, and the rectum washed out. As the stomach had evidently been wounded, I deemed it improper to allow nourishment to be taken into that organ. Accordingly, after the enema, about a half pint of beef essence and two ounces of wine whey were thrown up per anum and retained. Half a grain of morphia was then administered, and the patient left to repose. At 9 P. M. I found the patient's respiration very much embarrassed. There was pain and dulness on the left side; vesicular murmur absent. I opened by a probe the wound in the left side (which I should have stated had been closed with soft leather soaked in collodion), and so caused the discharge of a large quantity of blood, serum, pus, etc.; then cautiously enlarged this wound, and introduced a sponge tent. The difficulty and pain on breathing now ceased, and the respiration on the right side, which had been puerile, became vesicular. I now easily detected incipient pneumonia. I therefore ordered twelve cups to the chest, and fʒiss of tinct. opii, in a starch enema, to relieve pain.

The next day at 7 A. M. found the patient better; had slept a little, and has appetite. The rectum having been unloaded, twelve ounces of beef essence were injected. On removing the tent, the wound discharged some matter. Laudanum enema repeated at 9 P. M. The next morning at 7 A. M. found the man very uncomfortable and anxious, and complaining of colicky pains. Right lung was solidified, as it was dull on percussion, and tubular blowing was present. Sputa adherent to the vessel and more purulent. Pulse 110, and great pain on pressing the epigastric region. Twelve cut cups ordered; and at 2 P. M. beef essence enema. At 9 P. M. the patient was worse, peritonitis being well pronounced. The patient sinking; pulse 125, and very feeble. For the peritonitis, ordered sulphate of quinia, in ten grain doses per anum, in beef essence. Two enemata to be administered during the night. The next day at 7 A. M. the patient was a little better, but very weak. Ordered the quinia to be continued, and wine whey in enemata, every two hours. The patient had rejected iced champagne from his stomach. The sputæ were very tenacious; adhered to the vessel in which they were placed when it was inverted. Wound in left side discharging prodigiously. Has pain on pressure over the abdomen. At 9 P. M. found the man suffering considerably. Ordered a laudanum enema, the quinia to be given at 4 A. M. Next morning he was free from pain and much better. Quinia in small doses to be continued; beef essence and wine whey to be plentifully supplied. This treatment was continued until the patient's death, on the sixteenth day. The peritonitis yielded on the tenth day to the quinia treatment.

An inspection of the parts concerned showed the right lung solidified and engorged with pus. Left lung contained a cavity of the size of a turkey's egg, and was also much disorganized from the presence of pus in its tissue. The arrow had wounded the right lung, the liver, the stomach at its posterior and cardiac aspect, and, finally, the left lung. The wound in the stomach had healed, but the diaphragm contained two slits in it. The wound in the liver was open and communicated with the wound in the right lung. There were signs of recent general peritonitis.

CASE III. Santiago Orliz was shot in the left armpit by an arrow. The shaft of the arrow had been pulled out two days before I saw him, leaving the head firmly lodged in the fourth dorsal vertebra. The hemorrhage, I was informed, had been very great. His Mexican comrades restrained it by plugging the wound. I made an examination with a chest probe, but failed to detect the foreign body. I gave up the search, enlarged the wound, introduced a common tent, and contented myself with an expectant plan. In three days the wound discharged matter in large quantity. I again searched for the arrow-head but without success. The wound was made the depending part of the body, and I hoped that the foreign substance might make its way out, and, moreover, that empyema might be thus prevented. But all in vain, the man died asphyxiated from inability to throw off by his mouth the matter which was constantly being coughed up. Inspection ten hours after death showed a wound between the fourth and fifth ribs. The track of the arrow had healed for an inch or more, and thence was open to the fourth dorsal vertebra, which was found to have been wounded, the wound being filled up with a cartilaginous cicatrix. The pleural cavity was distended with matter, but did not communicate with the external wound; the pleura costalis and the pleura pulmonalis being united at this point. The pleural cavity communicated with the fistulous track in the lung tissue. I was deceived in this case; I supposed that the external wound would allow of the drainage of all the matter that could form, whereas, in fact, it did not allow of any discharge at all from the pleural cavity. I should have been more attentive to the physical signs in this case, and at least have made an exploratory puncture to determine the presence or absence of matter in the pleural cavity, and then I would have performed paracentesis. I found the arrow-head resting on the diaphragm, it having ulcerated through the pleura, and I have no doubt that in time it would have perforated the diaphragm and slipped into the abdominal cavity. It was very crooked; the long thoracic artery had been divided by the arrow-head, but no vessel of importance was injured.

CASE IV. Private Connor, of the third infantry, was shot by Nabajoes with four arrows, all through the lung. He was alive when I reached him, but died in a few minutes, apparently asphyxiated with the torrents of blood pouring into his bronchi. I found the vena cava descendens pinned to one of the vertebræ by an arrow-head. The aorta was pierced by a small arrow-head, the wounds in the vessels being plugged perfectly by the arrow shaft.

The lung may be wounded with arrows in several places, and yet the patient recover.

CASE V. A Mexican, name unknown, whilst travelling the road near Fort Defiance, was shot by Nabajoes with five arrows, all the arrows injuring the lung, and one of them passing through the upper border of the liver. I saw the man twenty minutes after the accident. The bleeding was most profuse, and the man fainted. Both lungs were wounded; I made the worst possible prognosis, but proceeded to extract the arrows, all of which I safely removed. After the hemorrhage had ceased, I applied muslin soaked in collodion to each of the wounds, eight in number, and had the patient put to bed, and given a grain of morphia. The next morning the patient was more comfortable than I had expected. He had been vomiting, and I gave him some acetum opii and acetate of lead, to quiet this and restrain secretion. In the afternoon the man complained of pain on the right side, and difficulty in breathing. I removed the dressing from the wound, involving the liver and lung, and broke up some clots where-upon a considerable quantity of mixed fluids were discharged from the wound. These contained bile as I discovered by Pettenkofer's test. This procedure greatly relieved him, and he expressed himself much better. I ordered the prescriptions of the morning to be repeated. The next day the patient vomited a considerable quantity of black decomposed blood, and complained of the frequency of his urination. Urine very dark coloured, sp. gr. 1036; urine contained cholic acid and sugar. All medicines ordered to be discontinued. After this the patient gradually recovered, all the wounds healing by first intention, except that implicating the liver, and that ceased discharging on the sixth day. In two weeks the man left the hospital, his urine still containing sugar, but no bile. He had passed during his illness about thirty-six ounces per diem. In a few days the last traces of sugar disappeared from his urine, and in six weeks from the day he was wounded, he returned to the post from a scout, in order to have removed a large polypus of nasal cavity, which had plagued him a great deal during his sickness.

This case is remarkable, showing, as it does, what injuries a man may sometimes survive. It also proves that wounds of the lungs sometimes heal by first intention,[1] and it illustrates a common occurrence after liver wounds, the presence of bile and sugar in the urine. It shows, moreover, that the hepatic peritoneum may be wounded by an arrow without death resulting, or the effusion of blood or bile into the cavity of the abdomen. Finally, it is a good example of the treatment proper in such cases. In this instance, as well as in two of the fatal cases of arrow wound of lung, emphysema was present. It was not particularly treated, save that, when possible, Guthrie's rule was observed, the patient lying on the wounded side.

If an arrow, passing through the lung, lodges in a vertebra, it is very apt to be fatal. For, independent of the danger of a wound of the lung itself, or of laying open one of the great vessels, or of penetrating the spaces between the vertebra, and so injuring the medulla spinalis, there still remains the danger that the head may become detached from the shaft of the arrow, and be left sticking in the bone. The prognosis in all cases must be very guarded.

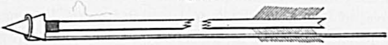
In addition to the third fatal case of arrow wound of chest before mentioned, we know of four others, not so well authenticated, it is true, but in which, from a careful inquiry among the friends of the deceased, we were persuaded that death resulted from empyema, the consequence of an arrow-head lodged in the walls of the thorax; we say not well authenticated, because we did not examine the bodies of the wounded men. We have not recorded these among the fifteen cases of wounds of the chest, although there is no doubt that one case out of fifteen is too small a proportion of deaths by empyema.

---

[1] We have noticed in New Mexico a great tendency of all wounds to heal by first intention. In an operation undertaken for the removal of an enchondrome of the vomer, involving a long and disfiguring incision on the face, the wound healed throughout by first intention and scarcely a sign of a cicatrix was left. Assistant Surgeon Irvin has called the writer's attention to the fact that in this country, gunshot wounds sometimes heal in this way, and although we have seen nothing of this kind ourself, we are yet very sure that all wounds heal much more quickly here than at the seaboard. When inflammation does occur it takes a typhoid type. I have not seen a case of sthenic inflammation in the country. It is necessary to remove sutures on the second day. If left longer they slough out. We nearly failed in a case of harelip by neglecting, or rather through ignorance of, this fact.

Let us now inquire into the treatment of an arrow wound of the chest. Take the following case which has occurred in the practice of the writer. I was called to a man shot with an arrow; the shaft was broken off close to the wound, and the splintered ends of the shaft closely resembled a splinter of a fractured rib. As soon as reaction was established (and shock is often severe in arrow wounds of lung) I attempted the removal of the missile, not by catching hold of the broken arrow shaft with strong forceps, and making traction with these, for if I had done so, I would inevitably have left the arrow-head in the wound. The first step in the removal of such a weapon is to ascertain its seat, its connections, its lodgment. First, it is proper to determine how deeply the arrow has penetrated. This can be done by measuring the length of the shaft sticking out of the wound, and deducting this from the total length of an arrow shaft of known length. The Nabajoe and Utah arrow is about two and a half feet long. The Apache, Camanche, Arrapahoe, Cheyenne, Kiowa, and Pawnee arrows are about two feet and three-quarters in length. Next we wish to determine whether the arrow-head is fixed in bone or not. Take the shaft between the finger and thumb, and gently twirl this. If the arrow-head is fixed, we can readily discover the fact by this motion. We then should notice its direction, and whether, considering the depth it has penetrated, it has wounded any great vessel. Here our anatomical knowledge avails us everything. We notice whether blood wells up along the side of the shaft, on pressing this latter aside. We determine whether the head has lodged in a vertebra, or a rib, and if in the last-named, in what rib, and in what part of that rib. We ascertain the exact seat of an arrow lodged in a rib, by first determining the rib, which is sufficiently easy, and then percussing gently the extremity of the arrow shaft with one hand, whilst a finger of the other is gently slid along the wounded rib backwards and forwards, until the point of greatest impact is determined; this is the spot where the arrow-head is lodged. All this having been settled, we may arrive at a prognosis. In the case we have referred to, I went through all these examinations. I found that the arrow shaft broken off, measured two feet and one inch, and I concluded that the lung was wounded to the depth of five inches. (It was a Nabajoe arrow.) The orifice of the wound was in the space between the fourth and fifth ribs, on the right side. The general direction of the shaft seemed to be that of a line drawn from the nipple to the inferior angle of the scapula. On twirling the shaft, by seizing the broken end of it with tooth-forceps, I found that the point was not lodged in bone. There was no hemorrhage, and the patient rallied from the shock quickly. In this case the prognosis was good, that is, for such a wound. A probe-pointed bistoury was used to enlarge the wound to the extent of an inch, keeping in view the situation of the intercostal arteries, lying as they do on the upper border of the rib in the first two inches of their course previous to their division, and after this division in the larger branch, sheltering itself beneath the lower border of the rib above it; a wire having a loop at the end, and bent at a right angle, was introduced, and pushed down through the wound (using the arrow shaft as a guide), until its loop was past the point of the iron arrow-head, and then slipping the loop over the point of this, and drawing the wire gently back, it was found from the sense of resistance that the loop had snared the treacherous body. Figure 1 illustrates better than words can describe, what is meant.

Fig. 1.



Extraction was of course sufficiently easy. Gentle traction applied to the arrow shaft and to the wire at the same time, sufficed to remove the arrow, without detaching the shaft from the head. The wound was then closed up with collodion dressing, and the patient directed to lie on the wounded side. Inflammation succeeded, but as it was not excessive, I was contented merely with watching it.

Suppose that from the difficulty in breathing, external welling up of blood, and, above all, the depth or direction of the wound, and the continuance of shock, it is made evident that a large vessel is wounded. In such a case there is, of course, no hope. Any interference with the arrow is injudicious, for if we were to extract it under such circumstances, in all probability death would result immediately. We can merely make the patient a little more comfortable in the few hours that are left to him.

If from the depth to which an arrow has penetrated, and from the direction it has taken, and more particularly, if on gently twirling the shaft between the finger and thumb, it is found that the arrow-head has lodged in bone, we must modify our proceeding. The first thing to be done is to determine accurately whether the foreign body has lodged in a vertebra, or in a rib. Here our anatomical knowledge must serve, together with the direction taken by the arrow. Suppose it is lodged in a vertebra, what is to be done? We enlarge the wound, as before ordered, and then very cautiously attempt to loosen the head from the bone in which it is lodged, by gently rocking the arrow shaft, held between the fingers, backward and forward. In what direction is it best to do this, in order not to loosen the head from the shaft of the arrow? If the arrow of any particular Indian tribe is examined, it will be found that the tribe always makes the two slits in the arrow shaft—the one for the string, the other for the stem of the arrow-head—either in the same plane, or in planes at right angles to one another; most Indians make them in the same plane. Thus the plane of the broad surface of the arrow-head always holds a fixed relation to the plane of the notch for the bow-string. To make this more evident, suppose the head is removed from the shaft of an arrow, and a straight bit of wire put in its place, at right angles to the shaft of the arrow, and another bit of wire laid in the notch for the bow-string; what we intend to state is that these two wires will point in the same direction, or else in a direction at right angles to one another. Before touching the arrow shaft, we notice what the direction of the plane of the notch for the bow-string is, whether it is horizontal or perpendicular, or between these two. We then know that the notch in the other end of the arrow bears a fixed relation to this, and is either in the same plane, or in a plane at right angles to it, according to the way in which the arrow is made by the tribe of Indians to which the arrow belongs. Having determined exactly what the plane of the notch for the head is, we should now rock the arrow shaft to and fro in a direction at right angles to this plane—the plane of the broad surface of the arrow-head. In this way the chances of loosening the head from the shaft are diminished. There are two places at which yielding may occur; either at the place where the shaft is attached to the arrow-head by the tendon, or else at the place where the head is implanted in the bone. Whatever the theory may be, the practice is to rock the arrow shaft in a plane at right angles to the broad surface of the arrow-head, and not parallel to it. This rocking motion should be both gentle and slight, and may, if these conditions are observed, be persevered in for some time. The Mexicans, in their frequent encounters of the Indians, have become aware of what has just been stated, and they apply it successfully to the extraction of arrows lodged in bone. We know of several instances in which it has been so applied by the Mexicans. Generally, however, it will fail, and if undue force is used the head and shaft of the arrow are sure to become detached from one another. If we succeed, we remove the missile in the same manner as we do an arrow-head not lodged in bone. Supposing, then, we have failed in this plan, what is left us? It will not do to allow the arrow-shaft, head and all, to remain in the wound till it becomes loosened by suppuration. The patient will be sure to perish of pneumonia. We have never had a case of this kind to treat, but have made numerous experiments on the cadaver with various kinds of forceps and other contrivances, and we have come to the conclusion that the following plan will suffice for the removal of arrows lodged in a bone within the cavity of the chest or abdomen most easily to the surgeon and most safely to the patient.

Procure a piece of very well annealed iron wire a little larger than the coarsest usually employed for sutures. Let this be about two feet and a half in length. Pass the ends of this wire through the holes in a very long

Coghill's suture wire twister (Fig. 2), and carry them up the shaft of this, securing their ends to the handle.[1] The loop at the end of the instrument made by the doubling of the wire should now be once twisted on itself and then bent at right angles to the shaft of the instrument. (See Fig. 3.) This shaft should be at least one foot in length. Then, the wound being sufficiently enlarged, we pass the loop at the end of the twister over the feather end of the arrow-shaft, and using this last as a guide, we push the instrument straight on till the loop of wire is carried beyond the arrow-shaft and is encircling the arrow-head. We now draw on one of the ends of the wire so as to make the loop embrace the arrow-head tightly, and then we secure the end of the wire to the handle of the instrument. One or two twists of this will now suffice to tighten the wire so that it cannot slip off from the arrow-head, and all that is now necessary is to make firm but gentle traction on the handles of the twister, gently rocking the arrow-shaft to and fro at the same time, in order to disengage the head of the arrow from the bone. We have never failed to extract an arrow-head lodged in bone within the thorax by this method. If the arrow-head is very firmly imbedded in the bone it will be well to throw two loops of wire by two twisters over it before making traction. In such a case traction is best made by fastening the handles of the two twisters to an inflexible rod, placing a block or pile of books resting on the patient's thorax under one end of this, and then applying force to the other end. In a word, in such cases it is well to use a lever of the second class to pry out arrow-head, shaft, wire loop, and twister, all together. No forceps ever constructed could be used successfully in such a case. The after-treatment of such cases presents nothing peculiar. The patient must be well guarded against shock.

Fig. 2.

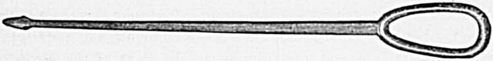
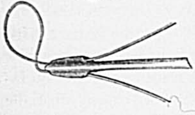


Fig. 3.



It is not easy by this method to extract an arrow-head which has passed through one side of the chest and lodged in a rib on the other, although such a wound as this is probably mortal. If the patient survive the shock and hemorrhage, the best plan for extracting the arrow-head is the following: Determine exactly by the process previously given, the part of the rib in which the arrow-head is lodged, then apply the trephine to this part of the rib, taking care not to injure the intercostal artery in its lower border. It is very easy to make the opening in the rib within the eighth of an inch of the arrow-head; sometimes we can hit the spot exactly, and on attempting to withdraw the circle of bone we find the arrow firmly imbedded in it. Nothing else is necessary than to cut off the part of the arrow-shaft which protrudes from the right side and draw the remaining portion out through the wound in the rib. But, as was before remarked, the prognosis in every such case is very unfavourable.

---

[1] A couple of silver catheters straightened and soldered together so as to resemble a large sized double canula for hæmorrhoids will answer in place of Coghill's instrument.

Arrow wounds of heart are generally fatal, although not always instantaneously so. In one case falling under my notice the man perished instantly. I found the ventricles of the heart and the descending aorta pierced by an arrow and spiked to a rib. In another case the man lived five minutes. The case was interesting in a medico-legal view, as it was devolved upon us to determine whether the man had been shot with a pistol ball from the weapon of a comrade, or with an arrow, so much did the wound resemble that made by a navy-sized Colt's revolver. I found the arrow-head lodged in a vertebra. It had pierced the top of the auricle.

Arrow wounds of abdomen are generally fatal. An arrow can scarcely pass through the abdomen and fail to open a vessel or wound an intestine. We have seen twenty-one cases of arrow wound of the abdomen. All save one, of those cases in which the abdominal cavity was implicated, terminated fatally. In three the integuments only were wounded, and in one the arrow had lodged in the crest of the ilium without wounding an intestine.

Of the seventeen fatal cases, thirteen perished from peritonitis and four from hemorrhage. All save two were wounded in the intestine, although two of those so wounded died from hemorrhage. Nine of the cases of peritonitis had been exposed to a broiling sun, without water, for two days. Five were dead, and none lived to reach the Post. The remaining four cases of peritonitis occurred in the persons of United States soldiers engaged against Nabajoes. In all, fecal matter was found discharged into the peritoneal cavity, the intestine being wounded.

The Mexicans, on entering into an Indian fight, wrap many folds of a blanket around the abdomen. Thus it happens that an arrow, after penetrating these folds, has not momentum enough left to do more than wound the integument, and fails to reach the abdominal cavity.

From all that has been stated it must appear that the prognosis in all cases of arrow wounds of abdomen is very unfavourable. Much, however, will depend upon the seat and extent of the injury, and upon the facilities for treatment and transportation. The treatment should take into consideration the extraction of the missile, the checking of hemorrhage, the removal of any discharged excrementitious matters, the suturing of the wounded intestine, and the preventing or suppressing of peritonitis. If the arrow-head is lodged on feces extruded through the wounded intestine, we consider that no surgeon should be satisfied without operating. It is difficult, however, to arrive at this information with certainty.

If called to another case of arrow-wound of abdominal cavity we would feel almost justified in enlarging the wound, laying open the abdomen, searching gently for wounded intestine, and removing the arrow-head if lodged firmly in bone, with strong short forceps. In any event, if this is not done the patient will die. For suturing the intestine we should look upon *very* fine gold wire with great favour; on gold wire because this metal is possessed of greater ductility than any other. If we are certain that an arrow-head has lodged in a bone of the pelvis, the course above indicated must be pursued, for in addition to the facility which an enlarging of the wound gives for extracting the arrow-head, there is thus afforded also an opportunity of suturing intestine requiring it, of removing foreign matters, and perhaps of checking hemorrhage. If it is decided upon to adopt an expectant plan, and, in fact, after any operation for removal of arrow-heads, opium must be given in full doses very frequently, until narcotism ensues, and starvation and absolute rest must be enforced. The patient must not be allowed to rise from the recumbent position for at least two weeks, and milk and light custard must be his only diet. We know of at least one instance in which an officer lost his life by insisting on leaving his bed before the tenth day. In every case, however, of arrow wound of abdomen, it is necessary to remember that the arrow-head must be extracted or the patient will die. It is the great distinctive rule between arrow and gunshot wounds of all other parts of the body as well as of the abdomen, *always to extract the foreign body, if it be an arrow.*

Such, then, are arrow wounds as we have seen them—a class of wounds as troublesome to the surgeon as dangerous to the patient. But in no class of wounds does surgical skill avail the patient so much or reward the surgeon so well for his trouble. Only never let him despair of his patient until he has operated in vain. An expectant treatment in such cases is really no treatment at all.

We wish in conclusion to recommend to those in authority the plan of protecting soldiers and others exposed to arrow wounds with a light cuirass. The Indians have a method of dressing bulls' hide for shields for themselves, which renders it arrow proof. A cuirass made of such material, protecting the whole trunk before and behind, need not weigh more than eight or ten pounds, and by means of it a soldier could enter an Indian fight with a fair chance of escaping death. Or perhaps the recently invented "bullet-proof vests" might be found better adapted to the service and equally effective. Certainly it is policy in fighting any enemy to make it as safe for ourselves as possible, and as dangerous for him. Sooner or later the government must undertake some great expedition against all the Indians of the plains. It may be possible to civilize Creeks, Choctaws, Cherokees, etc., but with a Cheyenne or Camanche or Apache the attempt will surely fail. The hands of these Indians ever have been and ever will be against every man. They are the professed exponents and great advocates of barbarism and universal ignorance. In view of any such plan of a general civilization of these tribes we think it should be the care of those who control such things to provide, as far as possible, for the safety of the soldier. We are certain that if suitable bulls' hide cuirasses were provided fatal wounds from arrows would become very rare. In all commands engaged against Indians an order should be issued warning the men of the danger of attempting to extract an arrow, and directing them in all such cases to go at once to the surgeon in attendance for assistance. From what has been already written, it is easy to see how great an advantage such a course will give a surgeon in the treatment of the injury.

FORT CRAIG, NEW MEXICO, Jan. 1, 1862.

ART. III.—*Inoculating the Human System with Straw Fungi, to protect it against the Contagion of Measles; with some Additional Observations relating to the Influence of Fungoid Growth in producing Disease and in the Fermentation and Putrefaction of Organic Bodies.* By J. H. SALISBURY, M. D., of Newark, Ohio.

IN the July number of this *Journal*, I presented some remarks on fungi, with an account of experiments showing the influence of straw fungi upon the human system, etc. At that time I had inoculated but thirteen cases. Since then there have been inoculated 27 additional cases, all of which were situated under the most favourable circumstances for testing rigidly the prophylactic virtues of inoculation with straw fungi, in protecting the human system from the contagion of measles.

About the 30th of May, 1862, measles made their appearance among the boys of the Ohio State Reform Institution, situated in Fairfield County, Ohio. They were introduced into the establishment by a boy who was taken into it before he had entirely recovered from the disease. The officers in charge were not acquainted with the fact till it was too late to remedy it.

June 2d, Drs. Effinger and Boerstler, of Lancaster, O., were called to examine the first cases. They at once pronounced the disease measles. June 4th, I received the following letter from Dr. Boerstler.

LANCASTER, June 2d, 1862.

My dear Sir: Sorry you have left. To-day was called in consultation, to Reform Farm, where they have 175 boys, twelve taken down with